ADAPTIVE EXPERT KNOWLEDGE

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Abstract

Adaptive Expert Knowledge is a knowledge-based system. It consists of two modules which are the Expert Knowledge module and The On-going test module.

Expert Knowledge module contains topics the student have to study. The topics are Speech, Vision and Motion of Robotic's domain. It is intelligent adaptive hypermedia where it will adapt according to the student's skills. During the study session, there will be an On-going test.

Not all students can have access to the notes. There will be links to the notes. Links A is for student who is in Low level. Their marks for the Pretest is below 7. the notes for Link A is detailed and more examples than another two links. The purpose is so that the student will learn more about the topics and understand better.

Link B is for Intermediate level students. The notes is lesser than the Link A. Students who are in Intermediate level can access Link A and Link B. The Intermediate level's mark is below 14 for the Pretest.

Link C is for the High level students. Their knowledge about the Robotic domain is more than another two levels. Their marks for the Pretest is more than 13 marks of 20. The notes are simpler and mostly in point form. This is because they don't need to read notes that they already knew.

The On-going test is the test which is inserted between the notes. The reason is to test the student's memory and help them to memorize better. Their marks will be calculated and display at the end of the learning session.

Acknowledgement

I am so grateful to Allah S.W.T. the Merciful because with His bless, I had completed this project on time and complete.

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1.0 Introduction

1.1 Introduction to System

Most of the students nowadays didn't understand what they read. Understanding story is a goal-directed process. Reading is one of many ways in learning. Most of people get information through reading but if they didn't understand what they read, misconcept can happen. For example, we take two students as model. Student A didn't attend the lecture but he read the lecturer's notes, as for Student B, he did attend the lecture and read the lecturer's notes. As a result, they had different level of understanding the notes and of course Student B understands better than Student A.

How could this happen? From my point of view, sometimes when we read, there are some phrases or words that we don't understand therefore many questions appears in our head. These questions represent the "knowledge goals" of the understander, things that the understander wants to learn about. Sometimes wrong information occured because these questions unanswered. The point of reading is to find answers to these questions.

This is the purpose of this system. It will try to make the user always in wonder about some certain facts. While reading the notes, the user will have to answer questions which will be put inside the notes. It will make the user understands better and will increase their curiosity. Believe it or not, this is the intelligence and the strenght of the system. This system is a knowledge-based system. It consists of three topics in

robotics' domain and Pretests. It also hyperlink to multimedia such as animation and sound.

Before the user can read the notes, they have to answer the Pretest which is one of the intelligence of the system. The reason why we put the Pretest before the notes is to know the user's prior knowledge about the subject. There are two characteristics of skill. The first characteristic is the topic. It consists of three topics of Robotic domain which are Speech, Motion and Vision. The second characteristic is the format of questions. There are four formats. Format A is Objective question, format B is Fill in the blanks question, format C is Diagram question and Problem solving is format D question.

The students will be characterized in level according to their skills. The marks will be given for each topic and formats of question. For topic, which is one of the characteristic of skills mentioned above will determine on which topic the student weak and as for the format of quesrions, there will be three levels of students which are level 1 resulted from summation of marks of format A and format B. Level 2 for marks of format C question and level 3 for marks of format D question. This level will determine style of instruction for the student.

The Pretest consists of 30 questions. There are three formats of questions which are objective, problem solving and fill in the blanks. These will guide the student through the study session. It also test the student' understanding and furthermore we will know the student's weaknesses for example, which format of question the student weak. We also can determine the topic the student have to study and style of instruction according to the student's level.

The second intelligence of the system is the Expert Knowledge module. Expert Knowledge module contains topics the student have to study. The topics are Speech, Vision and Motion of Robotic domain. It is intelligent adaptive hypermedia where it will adapt according to the student's skills. During the study session, there will be an On-going test.

The On-going test is insert inside the notes, meaning while reading the notes, the student has to answer questions at the same time.

The beauty of this system is, it is very interactive and user friendly. The user will be delighted to use as it is hyperlink to multimedia. Last but not least, reading is fun.

1.2 Project's scope

1 Domain of robotics

This system consists of three topics in Robotic domain. There are:

- Speech
- Motion
- Vision

2 Knowledge of user itself

The user who uses this system is opened to anyone even the novice user. When entering the system, the user has to answer the Pretest Question. From the result of the session, the system will determined in which level the student is and the system will adapt styles of instructions according to the student's level.

The user also has to know where left meaning he will resume doing the session he last did. In that case, it will safe the user time because the user will not have to do the same thing all over again.

3 Knowledge of administrator

The administrator play a role as a teacher. They have to make the notes fun, understandable and easy to navigate because the user who use this system is not only the students who are from the robotic domain.

Another job for the administrator is the maintenance of the system. The administrator have to manage the system, guide the students by keeping the students on the right track which means how the students understands the notes. The administrator also have to monitor the student. Through the Pretest session, the administrator will know the student's level and know how to tackle the student weaknesses by adapting styles of instructions specialized to the student's level.

1.3 Motivation

This system is created because :-

Today, most of the student didn't understand what they read. They just simply read to pass the exam. So, we create a system which hopefully can help the student to learn not just to pass the exam.

The student still can retrieve the correct information without any communication with the lecturer.

Most of the learning system didn't adapt to the student weaknesses. Students have their own way of understanding. The system just make the student read the notes, answer the test and give the result. So, we come out with this system which will trace the students's weaknesses and improve their skills of understanding the knowledge.

1.4 Objectives

Every systems has its own objectives including this system. The objectives are :

- Motivate student in understanding robotic and to make reading is fun.
- Guide the student according to their skills
- They will be tested with the On-going test while accessing the Expert Knowledge to achieve the Question-driven Understanding method
- The system has Cognitive Science principles. It will try to help the students study, for example remembering the facts. There are three approaches, which are repetition to overcome the problem of decay overtime forgetness. The well organized notes to overcome the forgetness due to the interference and by giving clues which help in understanding.
- Different students have many ways of understanding so this system will adapt to the student's skills and try to improve the student's knowledge by knowing their weaknessess.

1.5 The system intelligence

Every module in this system has intelligence. The modules are :-

1. **Pretest module**
   - test the students' prior knowledge
   - guide the student through the study session
   - test the student's understanding by knowing their weakness through the characteristic of skills which are the topics and the format of questions.
   - determine the topic and style of instruction
   - the system can recognize any ways of answering for the problem solving format.

2. **On-going test module**
   - Understand the knowledge through question
   - Use the Question-driven Understanding method
   - Clues will be enable if the student has problem to answer the question and the clues given is according to the student's level.

3. **Expert Knowledge module**
   - Intelligent Adaptive Hypermedia
   - Consists of On-going test which is inserted inside the notes.

1.6 Project's Limitation

This system has its own limitations. There are :-

- Not a web-based system
- It's a final year project, so it only covers necessary parts of the topic. The most important point is to reflect the features.
- The system is not complete in term of quantity meaning it only covers three topics of Robotic domain.

1.7 Project Development Life Cycle

System Development Process is a set of activities, methods, best practices, deliverables, and automated tools that stakeholders use to develop and continuously improve information systems and software.

While System Life Cycle is the factoring of the lifetime of an information system into two stages, (1) system development and (2) system operation and maintenance- first you build it; then you use and maintain it. Eventually, you cycle back to redevelopment of a new system.

There are eight phases in System Development Process. The phases are :

- Scope Definition

- Problem Analysis
- Requirement Analysis
- Logical Analysis
- Decision Analysis
- Physical Design and Integration
- Construction and Testing
- Installation and Delivery

2.0 Literature Review

2.1 Introduction

The purpose of the literature review is to find any related information about the system that we intend to develop. It is also important for us to select better software, tools and approaches. Without the literature review, we will not be able to identify the strength and weaknesses of each tool. Surprisingly, it also helps the students to develop their information seeking and critical appraisal skill.

2.2 Adaptive

Fit; modify; alter for a new use. For this system, adaptive means the style of instructions for example the tests and clues are adapt or individualized according to the student's level or skill. As we know different students have their on way of understanding. Some student understands quickly and some are don't.

2.3 Expert knowledge

The major differences between expert and no expert is the knowledge the expert possesses on a problem. Davis' (1983) puts this point in an interesting way. He states that " the absolute value of an expert is the knowledge that he or she possesses on a given problem."

|Expert| = Expert – No expert = Knowledge

The domain expert or an expert has the expert knowledge meaning he has skills and knowledge to solve a specific problem in a manner superior to others.

Expert knowledge is a combination of a theoretical understanding of the problem and a collection of heuristic problem-solving rules that experience has shown to be effective in the domain.

Heuristic knowledge describes as rules-of –thumbs that guides the reasoning process. It is offend called a shallow knowledge. It represent the knowledge compiled by an expert through the experience of solving past problem.

2.4 Knowledge Base

The knowledge base contains highly specialized knowledge on the problem area as provided by expert. It includes facts, rules, concepts and relationship.

In general, a knowledge base is a centralized repository for information: a public library, a database of related information about a particular subject. In relation to information

technology (IT), a knowledge base is a machine-readable resource for the dissemination of information, generally online or with the capacity to be put online. An integral component of knowledge management systems, a knowledge base is used to optimize information collection, organization, and retrieval for an organization, or for the general public.

A well-organized knowledge base can save an enterprise money by decreasing the amount of employee time spent trying to find information about - among myriad possibilities - tax laws or company policies and procedures. As a customer relationship management (CRM) tool, a knowledge base can give customers easy access to information that would otherwise require contact with an organization's staff; as a rule, this capacity should make the interaction simpler for both the customer and the organization. In general, a knowledge base is not a static collection of information, but a dynamic resource that may itself have the capacity to learn, as part of an artificial intelligence (AI) expert system, for example. According to the World Wide Web Consortium (W3C), in the future the Internet may become a vast and complex global knowledge base known as the Semantic Web.

2.5 Traditional Computer Aided Learning System

The predecessors of *Intelligent Tutoring Systems* were known variously as *Computer Aided Instruction* or *Computer Aided Learning* systems. These traditional systems were developed to provide users with instruction in a particular area after which they were

tested. Answers to questions, usually multiple choice, were used to direct the course of study. The structure of the system can be seen in figure 2.1.

Users are presented with information after which a series of question are asked. If the user answers correctly the next phase of instruction is entered. There may be a summary set of questions at the end of the instruction to gauge how well the student has performed.

If a user answers the questions incorrectly the instructional material is presented again, perhaps in a slightly different format. If, after the material has been repeated, the student again answers incorrectly then remedial instruction may be presented.

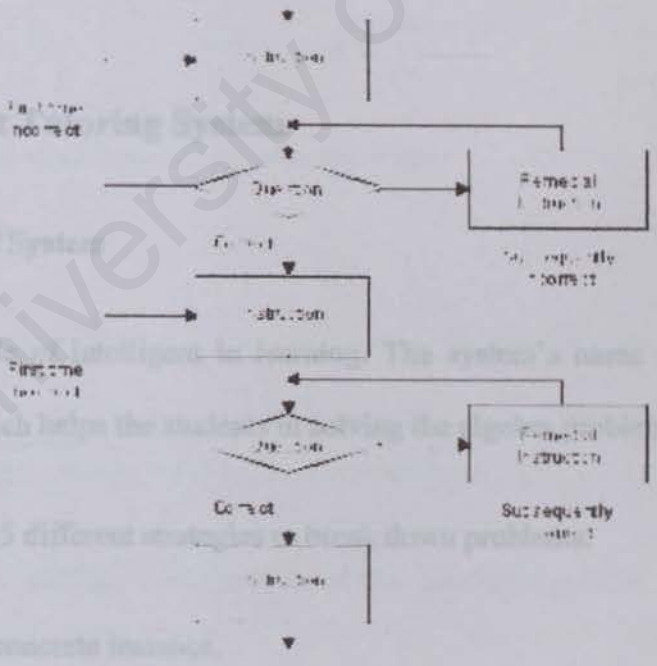


Figure 2,1 : Routing within a Computer Aided Instruction System

This style of tutoring system is often referred to as an ad-hoc frame oriented system. The branching structure within the systems can be a good deal more complex than that depicted in figure 2.1.

Such systems can appear to imitate intelligence by being able to adapt to student misconceptions. However, this appearance is a result of the system designer anticipating all possible errors that the student can make. These are built into the system at design time and encoded within the branching structure. If the designer of the system do not have anticipated an incorrect interpretation of the instructional material that the student may have, the system will never be able to provide an explanation that will help resolve the misunderstanding. These systems are incapable of dynamically generating a response to a particular situation as a human tutor would be able to do.

2.5 Intelligent Tutoring System

1. Example of System

This is the example of intelligent in learning. The system's name is "Ms. Lindquist Algebra Tutor" which helps the students in solving the algebra problem.

Ms. Lindquist uses 5 different strategies to break down problems:

1. Rephrasing as a concrete instance.

2. Identifying what the student needs to find first and asking them to phrase it in English before phrasing it in symbols.

3. Giving an example and asking the student to explain what is going on.

4. Introducing a new variable.

5. Giving the student the answer and then moving on to a new problem.

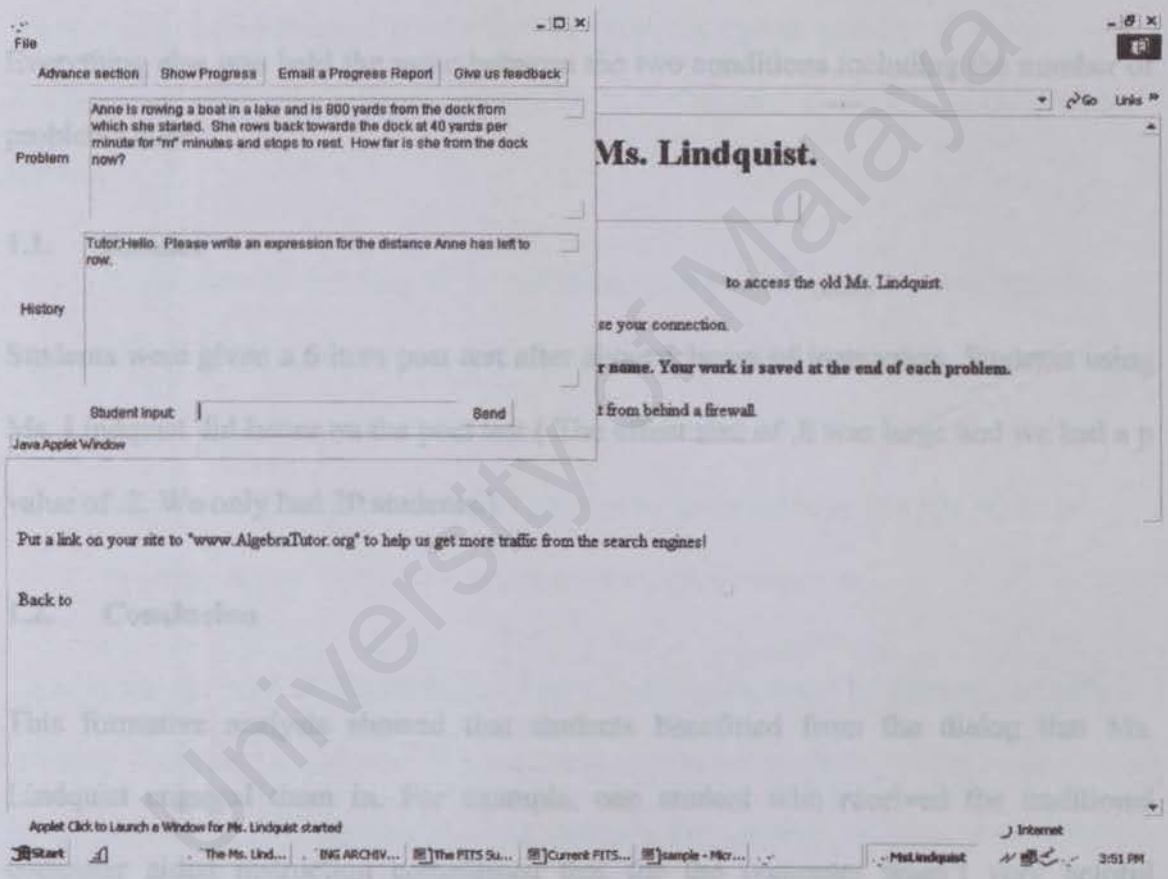


Figure 2.2 : An interface of Ms. Landquist system

Comparison between Intelligent Tutoring System and Traditional Computer-Aided Instruction.

- **Ms. Lindquist** is able to carry on a running conversation, complete with probing questions, positive and negative feedback, follow-up questions in embedded sub-dialogs, and requests for explanation as to why something is correct.
- **Traditional Computer-Aided Instruction(CAI)** simply told the students the answer if the student got a question wrong. The example of this condition is student doing homework with the answers in the back of the book but no additional help.

Everything else was held the same between the two conditions including the number of problems done.

1.1. Results

Students were given a 6 item post test after about 2 hours of instruction. Students using Ms. Lindquist did better on the post test (The effect size of .8 was large and we had a p value of .2. We only had 20 students.).

1.2. Conclusion

This formative analysis showed that students benefitted from the dialog that Ms. Lindquist engaged them in. For example, one student who received the traditional computer aided instruction complained that the the computer wasn't very helpful because "It just tells you the answer." Ms Lindquist instead asked new questions of students to try to break the problems down for them. These results show that the dialogs Ms. Lindquist engages students in is effective in promoting student learning.

2. Example of the second system

This is another example of Intelligent Tutoring System which is called Andes-An Intelligent Tutoring System for Physics.

This project is building a physics tutoring system, named Andes, that is based on the latest research in Cognitive Science as well as input from a team of physics instructors with years of experience in instructional reform. The project started in September, 1995. When Andes is completed, it will be used in university classes at the U. S. Naval Academy and secondary school classes in the U. S. Department of Defense Dependent Schools.

- To increase the learning of the participating physics students by making more effective use of the time they spend studying examples and solving problems.
- To advance their understanding of how students learn difficult and sometime counterintuitive subjects such as physics by studying how different styles of tutoring change students' learning processes and outcomes.

To advance the state of the art in Intelligent Tutoring Systems by finding methods for teaching fundamental concepts (e.g., acceleration, velocity, force, energy, momentum) in the context of their application, and methods for teaching students more effective learning habits.

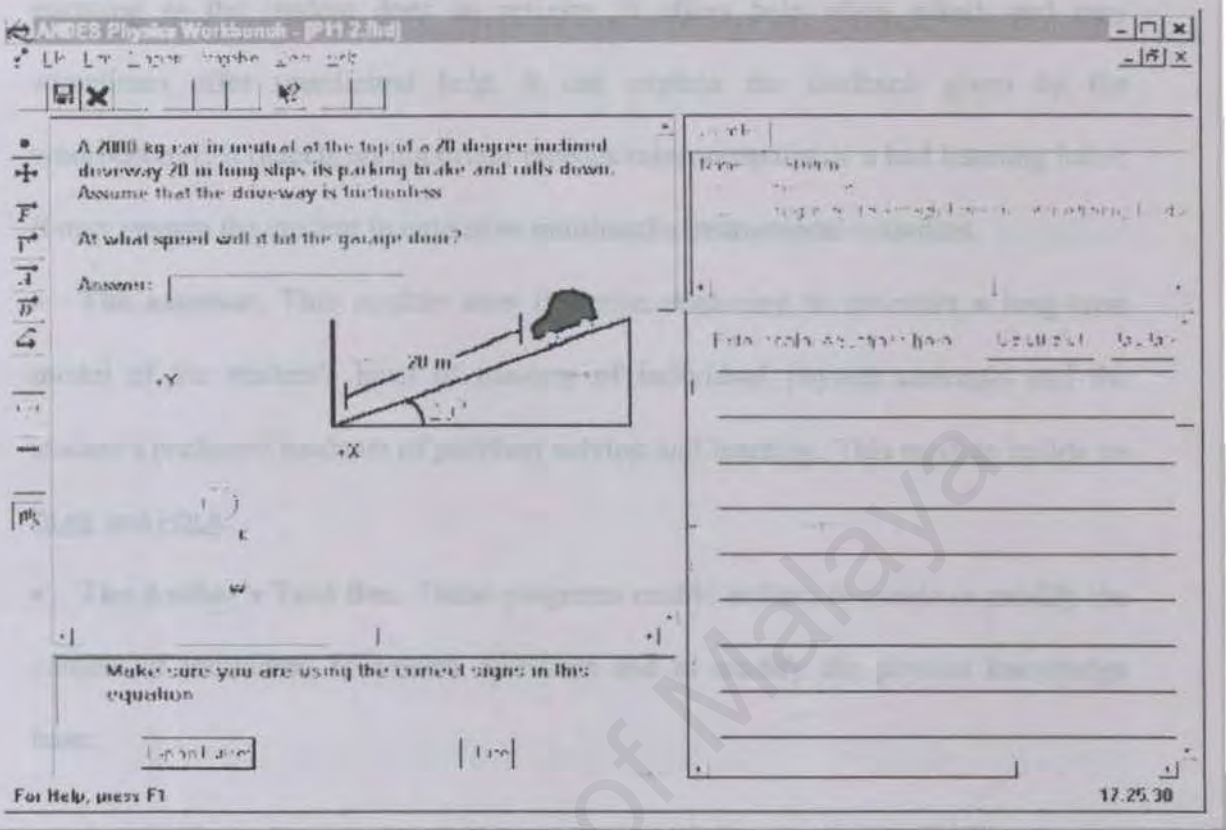


Figure 2.3 : An interfacwe of ANDES system

2.1 System Components

- **The Homework Assignment Editor.** This program is used by instructors to create homework assignments.
- **The Tutor.** This program is used by students to do their homework. It consists of the following modules:
- **The workbench.** The student selects activities and does them. The workbench includes tools, such as a calculator and an algebraic equation solver. It can give simple right/wrong feedback on both final answers and intermediate results. For lightweight applications, it can be used alone, without the rest of the tutor.

- **The helper.** This module tries to understand what plan or goals the student is pursuing as the student does an activity. It offers help when asked, and may sometimes offer unsolicited help. It can explain the feedback given by the workbench. If it detects an important physics misconception or a bad learning habit, it may engage the student in extensive multimedia instructional activities.
- **The assessor.** This module uses Bayesian reasoning to maintain a long-term model of the student's level of mastery of individual physics concepts and the student's preferred methods of problem solving and learning. This module builds on OLAE and POLA.
- **The Author's Tool Box.** These programs enable authors to create or modify the content of individual homework activities and to modify the physics knowledge base.

2.6 Microsoft Visual Basic 6.0

There are many reasons why we chose Microsoft Visual Basic 6.0 as our programming language and GUI (graphical user interface). The strength of this programming language are :-

It runs faster and competitive with C++ for object-oriented program development.

Incorporates many helpful features in the editor, making it easier for beginners as well as advanced programmers to enter and edit code. For example :-

- Drag-and-drop editing for moving and copying lines
- Pop-up lists of available data types when declaring variables

- Pop-up lists of allowable properties and methods for controls
- Tips showing format and arguments for functions and statements that appear automatically as you enter program code

Is easier to debug for example :

- Data tips, similar to tool tips, display the current contents of variables, properties and expressions, and pop-up when you point to the expression during break time.
- You can easily set breakpoints in code by clicking in a margin of a statement.
- During break time, you can drag the highlighted line to set the next statement to execute.

Includes controls such as :-

- ActiveX controls for programming on the Web.
- A new Web Browser control that allows you to retrieve and display Web pages in application.

2.6 Macromedia Flash MX 2004

These are the new features in Macromedia Flash MX 2004. I chose to use this software because of this features.

1. Timeline Effect and Behaviors

Simplify common timeline and scripting tasks with new Timeline Effects and Behaviors. Create common timeline animations with one-step Timeline Effects, reducing the need

for excessive key framing. Reduce the need to script simple tasks such as media and navigation controls by using behaviors.

2. Extensibility Architecture and Third-Party Extension

Third-party developers can extend Macromedia Flash with significant new capabilities. Create charts and graphs, animate text effects, deploy high-resolution interactive bitmaps, add raster effects, and design 3D graphics, all without leaving Macromedia Flash.

3. Improved Runtime Performance

It enhanced compiler and consists new Macromedia Flash Player 7, which together boost runtime performance by 2-10x for common applications. Improvements include faster graphics display, video playback, component initialization, and XML parsing, as well as better memory usage.

4. EPS and PDF File Support

Integrate rich-media content faster with direct support for PDF and EPS (Adobe Illustrator 10) files. Import and map files into the Macromedia Flash interface with a variety of settings, such as segmenting layers and pages into the library and timeline.

5. Alias Text

Produce crisp, highly legible text that's optimized for display at small sizes and on low-resolution displays such as mobile phones and devices.

6. Productivity Features

Improve the workflow with new features such as a built-in Spell-Checker, Search and Replace, a Deployment Kit, and reusable Publish settings. Create macros with the new History panel and with custom commands. Ensure consistent text formatting between Macromedia Flash and HTML content with Cascading Style Sheets.

7. Accessible Authoring and Components

We can create accessible content using new Microsoft Access Accessibility-compliant components for screen readers and keyboard access systems. We also can take advantage of improved support for dynamic accessibility scripting by using Action Script to place accessible tags during runtime.

8. Globalization Tool

Leverage full Unicode support to use, render, and save any font and encoding supported by the operating system, including double-byte character sets. Simplify and manage multilingual content localization and deployment with the Strings panel.

Action Script 2.0

We can take advantage of Action Script 2.0's more robust programming model and object-oriented programming support, which makes it more familiar to experienced Java programmers.

9. Jump-start features

We can boost the productivity with the new Start page, Help panel, and templates. Import and edit video clips more easily with the Video Import wizard.

3.0 Methodology

3.1 Introduction

System development methodology is a standardized development process that defines a set of activities, methods, best practises, deliverables, and automated tools that systems developers and project manager are to use to develop and continuously improve information systems and software.

For this system, we use Waterfall methodology as a system development methodology. There are 6 phases which are :

1. **System requirement**

   The first is to understand the topic and establish system requirement. As the beginning, the feasibilities studies, definition of overall objectives, limitation and scope of the project have been done. Besides, the title of the project has been studied carefully. Aims of this phase are to explore the concept and requirement elicitation. This step is very important because addressing the wrong objectives and scope of the system will pretty affect the outcome of the project. Besides that, other task carried out in this phase will be literature review on the domain robot and the equation used.

2. **System analysis**

The next step is to analysis the system needs and chooses the suitable system development technology to develop Adaptive Expert Knowledge. Besides that, analysis on the functional requirement and non-functional requirement of the system is also made during this phase. The aims of analysis phase are to describe in detail what the project should and suppose to do. The information about related topics has been found through reference books, literatures and some sources from internet. All the analysis done on this phase is very crucial and important for the following step, which is the system design.

3. **System design**

The system design process and translates the established requirement from the first stage into either hardware or software systems. This stage establishes overall system architecture. It also involves drafting out the data flow diagrams that resembles the functionality of the system and its subsystems or links.

4. **System Development**

Designing is the next phase that has been taken. In this phase, several basic modules that should be existed in the system have been defined. Major task in designing phase are designing architectural design, detailed design and detail description how the project is to be implement.

5. System Implementation

Implementation phase includes coding, testing, system integration and system acceptance. During coding, a system prototype will be completed first. With prototyping method, test and modification of the system can be done simultaneously. While in testing, it is done parallel with coding and the constraint of the system is to be checked. When the testing and modification has achieved a consistent stage, then it is time to implement the system.

6. Maintenance

Maintenance takes place after the system is installed and put into practical use. It involves correcting the errors that being encountered, which were not discovered in earlier stages of the life cycle, improving the implementation of the system units and enhancing the system's services as new requirement and discovered. Making these changes may involve feedback to some or all of the previous stages and the development are set back to the stage again. This stage is part of the life cycle software product, and not of the strict development, although improvements and fixes can still be considered as development. Maintenance for the system has to be done from time to time.

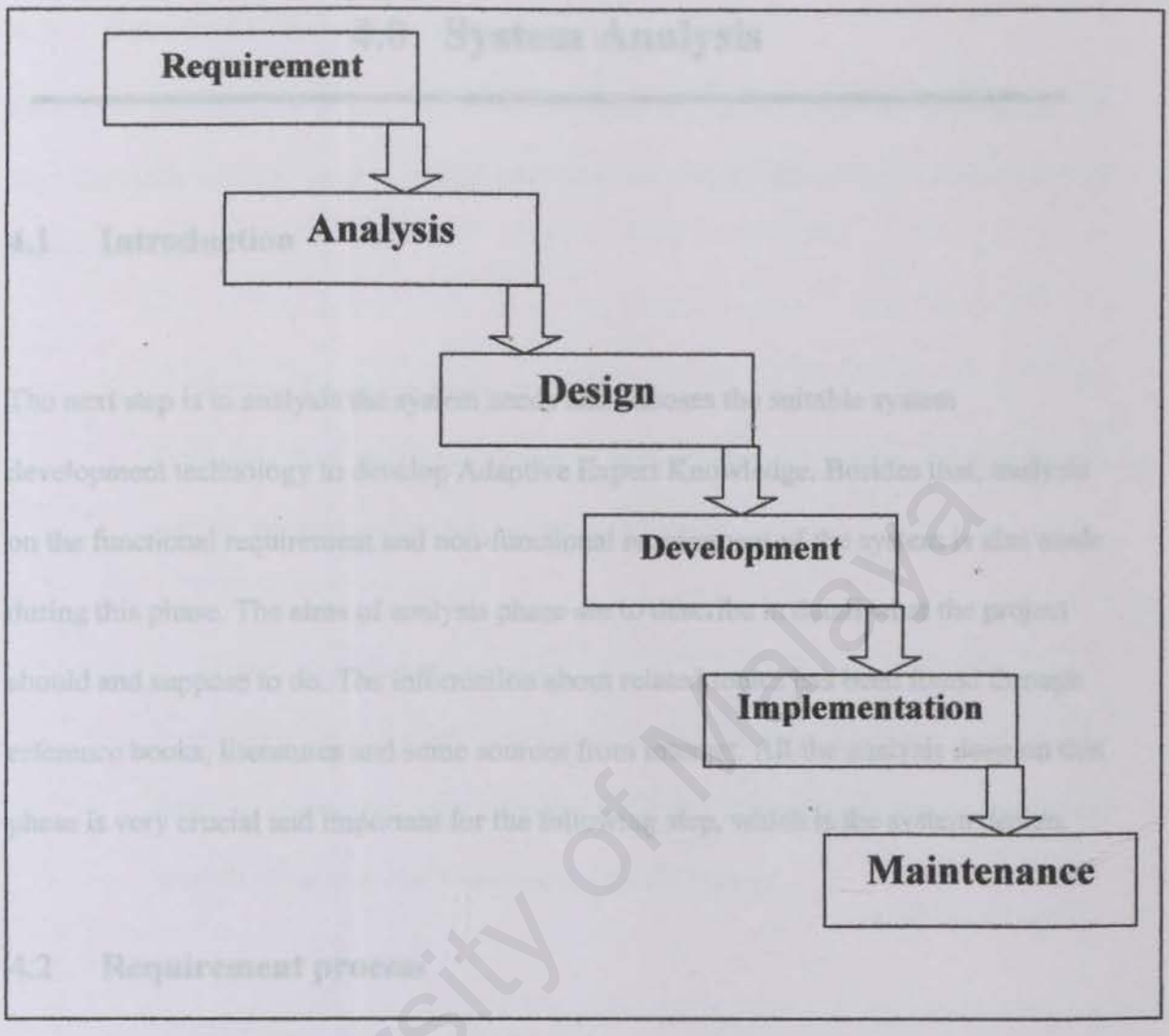


Figure 3.1 : Waterfall methodology

4.0 System Analysis

4.1 Introduction

The next step is to analysis the system needs and chooses the suitable system development technology to develop Adaptive Expert Knowledge. Besides that, analysis on the functional requirement and non-functional requirement of the system is also made during this phase. The aims of analysis phase are to describe in detail what the project should and suppose to do. The information about related topics has been found through reference books, literatures and some sources from internet. All the analysis done on this phase is very crucial and important for the following step, which is the system design.

4.2 Requirement process

A requirement is a feature of the system or the description of something the system is capable of doing in order to fulfill the systems purpose. For this project, the requirements were gathered through research on the internet and books.

4.3 Functional Requirement

Functional requirement is the interaction between the systems and its environment. It also describes how the system should behave given certain stimuli into sub-modules as mentioned earlier.

1. **Authentication module**

   For a new user, they have to sign in before using the system. All their marks will be restored and shown before they log out.

2. **Expert Knowledge module**

   In this module, there will be notes uploaded which is in robotic domain. The notes is interactive, easy to understand and enjoyable because sounds and animations is included to arouse the user's interest.

3. **Administrator module**

   The administrator's module is the maintenance of the system. The administrator have to manage the system, guide the students by keeping the students on the right track which means how the students understands the notes. The administrator also have to monitor the student. Their marks will be recorded and will be shown as a graph.

4. **Pretest Module**

Every time after the user log in, they will have to answer the Pretest questions. It is just a simple question and the purpose of this module is to test the user's prior knowledge about the topic. The button for the topic's notes will be disfunction if the user's mark for the topic is high. There are four format of questions which are objective, fill in the blanks, diagram and problem solving.

5. **On-going test module**

During the study process, the students will be test by simple questions which is included inside the notes. The purpose is to test the student's understanding and to increase their inquiries about the subject. The question is in objective format.

4.4 Non-functional Requirement

Non-functional requirement is a restriction on the system that limits our choicees for constructing a solution to the problem. It also narrows our selection language, platform or implementation techniques or tool; however, the selection is made at the design stage, after the requirement has been specified. There are :-

1. **User-friendly**

The system is a user-friendly system because it uses the international language on the navigational button and hyperlink text which is easy to understand. The instructions also easy and suitable to students to use.

2. **Attractive interface**

This system is a learning system so it must be attractive so that it will increase the students interest.

3. **Easy to navigate**

This system use buttons and hyperlink texts which is link to each other so, it is easy for the user to browse within this system. The instruction is easy.

4. **Interactive**

This system interactive with the user because it adapts to the user skills by the answers and clues which will be provided. If the user having difficulty in answering the test, they can have the clues so that they will have the idea to answer the question.

More than that, during the study session, if the user maybe have some question arise in their mind, we will answer the questions through the on-going test question. The on-going test question consists of questions that possibly occur in the user's mind.

5. **Meet the user satisfaction.**

Every single question that arise in their mind or do not understand while the study session will be answered. This system try to adapt to the student's skill and try to improve their knowledge through the modules.

6. **Security**

Security will be provided because it is a private study session.

7. **Mediate the Student's Learning**

Intelligent on-line learning as a platform to help the student learn according to the student's skills.

4.5 System Characteristic in the Design

There are four characteristics in the design which the system will be used. There are :-

- Question-driven understanding
- 6 levels of Blooms Taxonomy
- Cognitive Science
- Adaptive Hypermedia

1. **Question-driven understanding**

Reading is a Goal-directed process. The point of reading is to find answers to these questions which arise in the reader's mind while reading. The Questions represent the "knowledge goal" of a reader; things that the reader wants to learn about.The main point is to instigate student's thinking skills that is driven by his questions and goals to acquire knowledge.

2. **Cognitive Science Principles**

There are three factors of forgetting which are decay overtime, interference and lost of strenght. In order to avoid all these system we implement the rehearsal method overcome the decay overtime problem. As for the interference problem, we overcome it by giving clues to the student, so that their attention is always on the study session. They will concentrate to think about the clues given. To overcome the lost of strenght factor, the Expert Knowledge module is arrange in an organized way so that the student will understand the flow of knowledge.

3. **Adaptive Hypermedia**

This system also equipt with hypermedia texts so that the user easy to navigate through the pages.

4. 6 levels of Blooms Taxonomy

There are six levels in learning which are stated in the table below.

HIGH	1. Create 2. Compose 3. Invent 4. Hypothesize 5. What would happen if... 6. Design 7. Be original 8. Combine from several sources	**SYNTHESIS--** Create
HIGH	1. Give an opinion 2. Judge 3. Rate-best, worst, etc. 4. Choose 5. Recommend 6. What to do differently...	**EVALUATION--** Judge
HIGH	1. Categorize 2. Compare/contrast 3. Like/different 4. Cause/effect 5. Relevant/irrelevant 6. Find fallacies 7. Fact/opinion	**ANALYSIS--** Relationships
MIDDLE	1. Use what you learned in school in another place or situation	**APPLICATION--** Use
LOW	1. Tell 2. Find 3. Summarize in your own words 4. Locate 5. Name	**KNOWLEDGE, COMPREHENSION**

Table 4.1 : 6 Levels of Bloom Taxonomy

4.6 Development tool

- **Software Tool**

Microsoft Visual Basic 6.0

- **Operation System**

  Windows XP

- **Processor**

  Pentium 4

- **Graphical User Interface**

  Microsoft Visual Basic 6.0

- **Sound Card and Image Card**

- **Animation**

  Macromedia Flash MX 2004 version 6.0

  Microsoft Visual Basic version 6.0

5.0 System design

5.1 Introduction

System Design is defined as those tasks that focus on the specification of a detailed computer-based solution. It is also called a physical design.

5.2 System Structure Chart

The figure below shows the flow of the implementation of the system. The sudents with different skills and knowledge will have their own style of instruction because the system adapt to their skills. For example, for topic A, there will be three styles of instruction which are for level 1 students and so on.

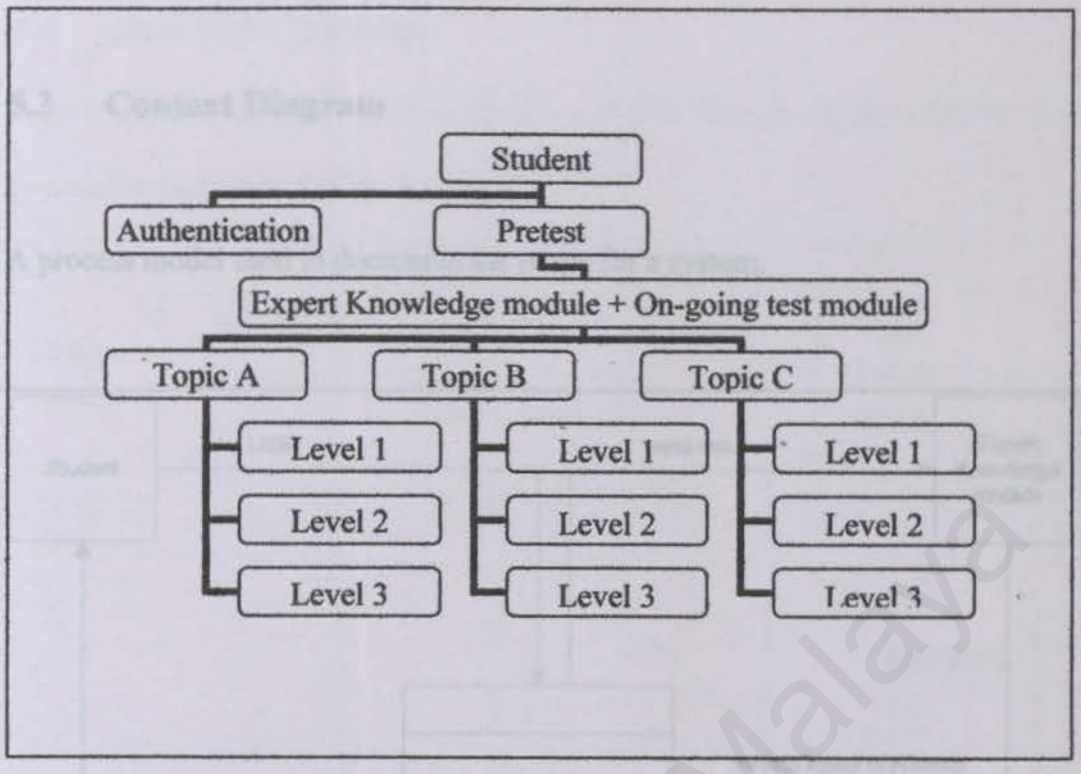


Figure 5.1 : The System Structure Chart

5.3 Context Diagram

A process model used to document the scope for a system.

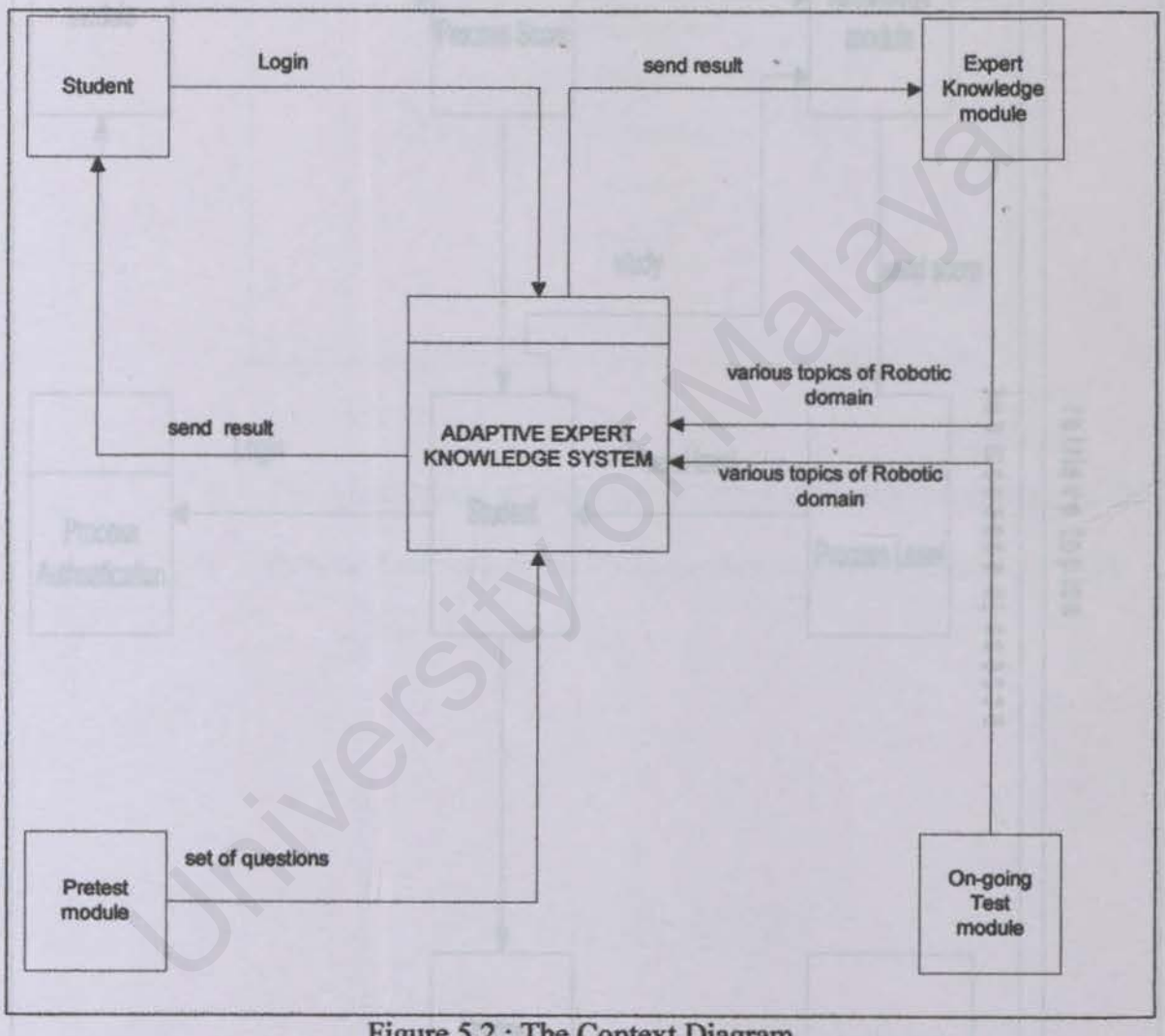


Figure 5.2 : The Context Diagram

5.4 Data Flow Diagram

A process model used to determine the flow of data through a system and the work or processing performed by the system.

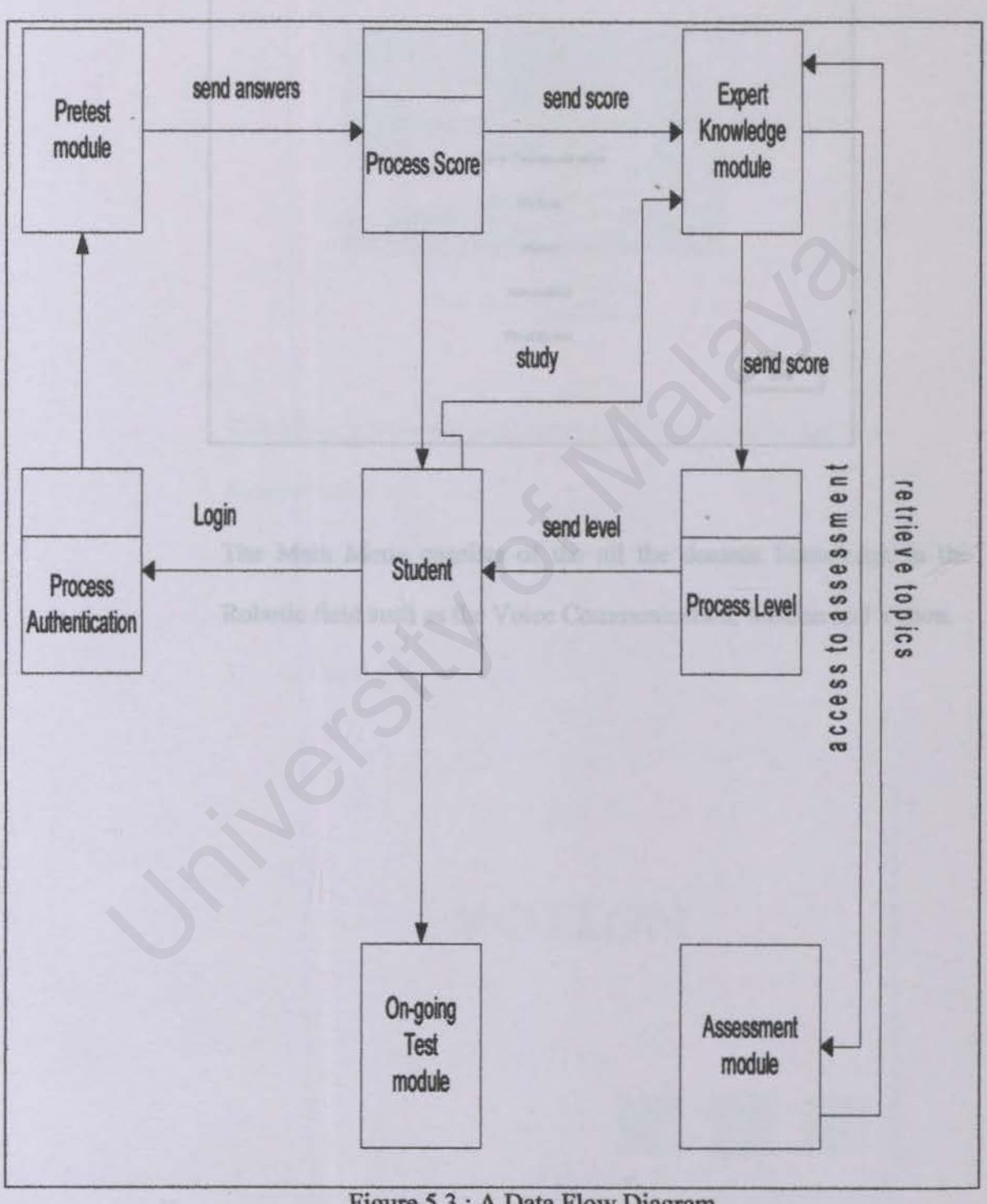
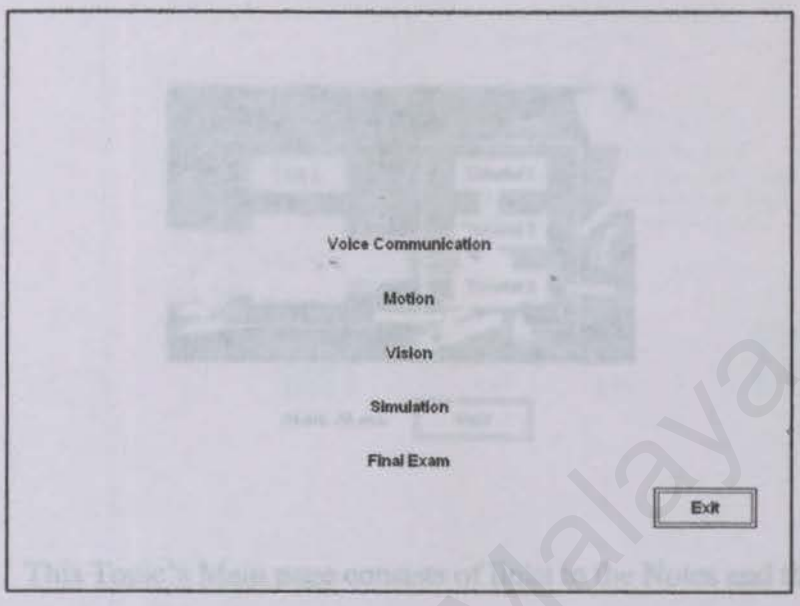


Figure 5.3 : A Data Flow Diagram

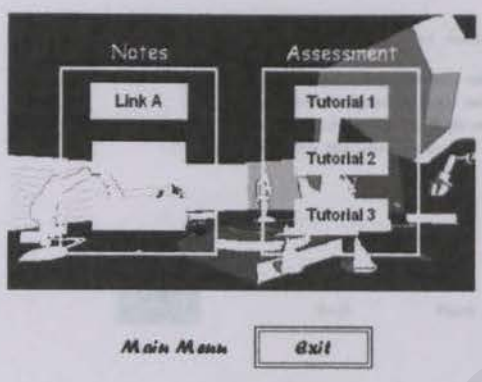
5.5 Interface

1. The Main Menu



The Main Menu consists of the all the domain knowledge in the Robotic field such as the Voice Communication, Motion and Vision.

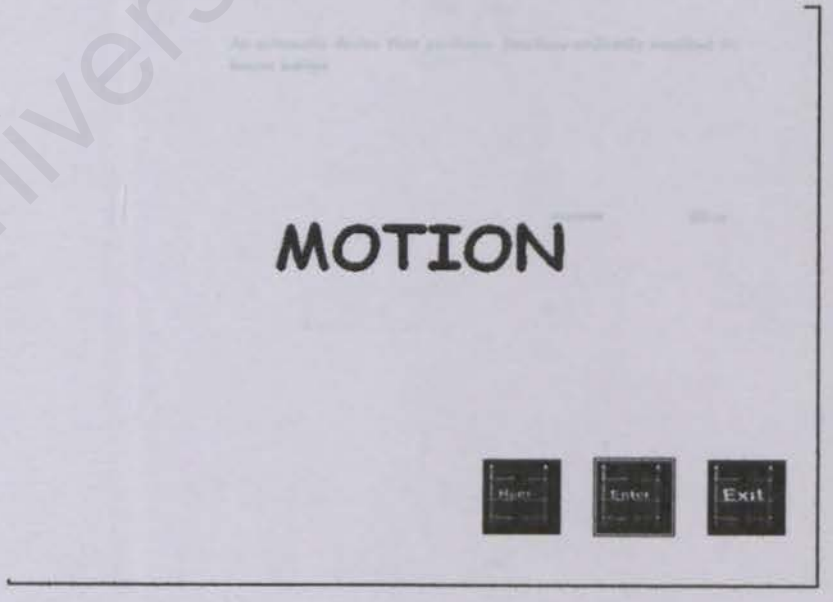
2. The Topic's Main page

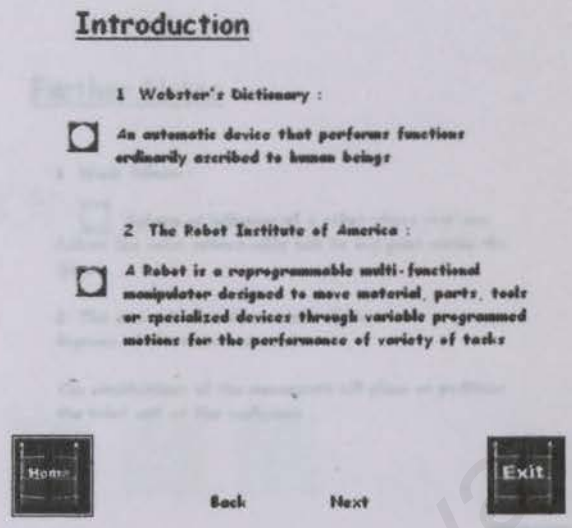


This Topic's Main page consists of links to the Notes and the Assessments.

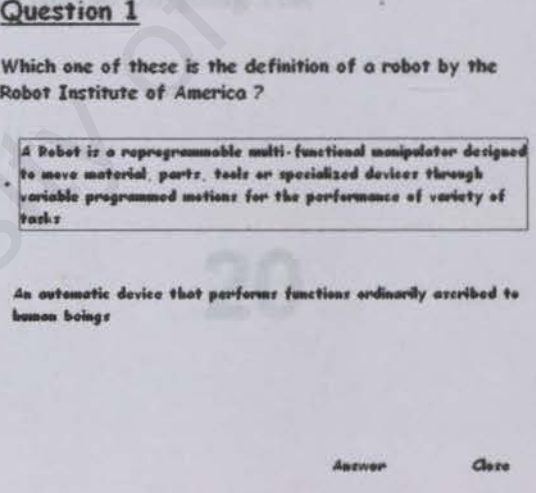
Users can only access to certain links of notes according to their level.

3. The Notes

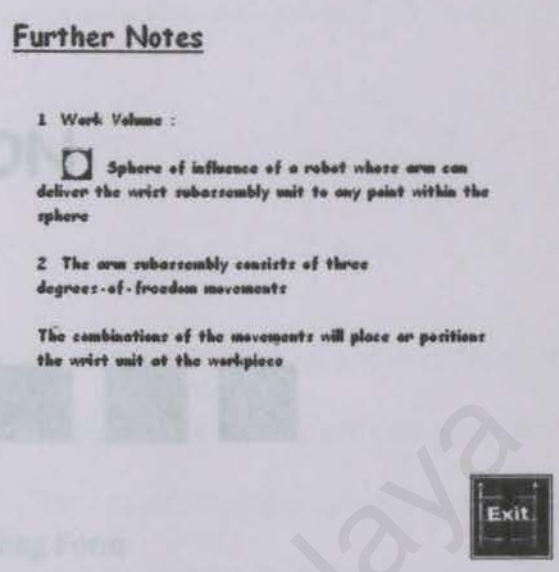




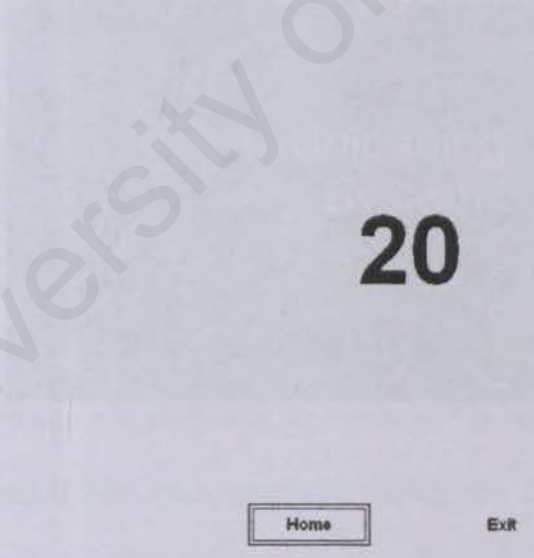
4. The On-going Test



5. The Further Notes

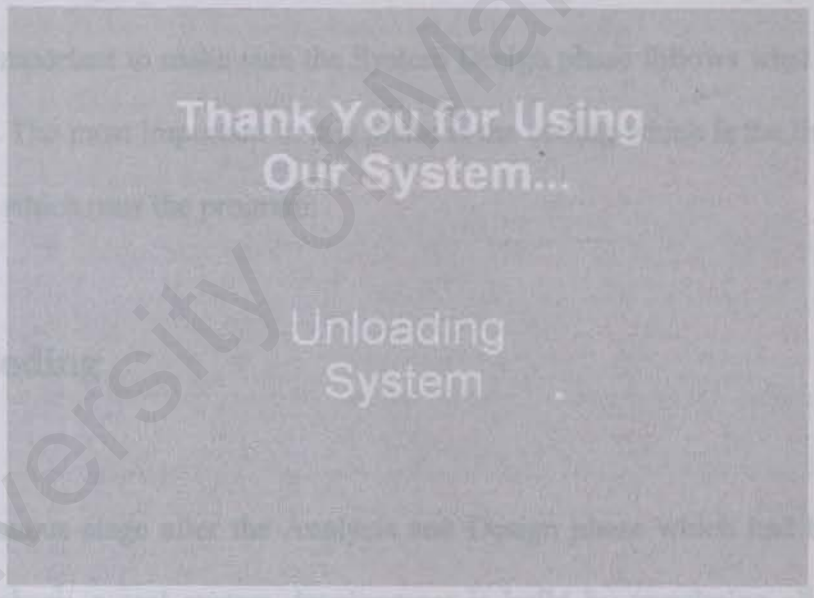


6. The Score for the On-going Test



MOTION

7. The Unloading Form



6.0 : SYSTEM IMPLEMENTATION

5.1 Introduction

System implementation is a phase where the design module or a system function will be integrated based on its necessity. At this phase, the coding process starts and it took quite a long time to build a system. The implementation of this system was done according to the system design which had been created in Analysis and Design phase. This revision is very important to make sure the System Design phase follows what had been proposed before. The most important in this phase is the coding which is the list of the programming sets which runs the program.

5.2 System's Coding

This phase is a continuous stage after the Analysis and Design phase which had been done before. In this phase, a real system development is build by translating all the programming logic which had been prepared during the System Design phase to instructions code in a programming language.

The programming module codes were tested and analyzed to get the recommended results and to decrease any errors which might occured during the implementation.

6.2 The coding approaches

A quality system design should have the characteristics which helps to produce a quality product which is understandable, easy to implement, tested and reconstruct and also suitable to any applications. During the coding process to develop the system, there are a few programming pebdekatan takens. The programming concepts which can be taken during the coding are :

1. **Cohesion**

   Cohesion between the components is a measurement of the closeness in the relationship. A component should implement one logical function or implement only one logical entity.

   This is the uniqeness where a unit only represents a sub part in the solution process and cohere with the other units.

   If there are changes to be made to the coding, a programmer just has to change the specified unit and need not to change all the system's coding,

2. **Compiling**

   Compiling concept is also quite similar to cohesion process. This concept stress on the bondage between a coupled modules if the modules shared or have the same variable or exchange information. Through this concept, any global information can be access and put in any part of the coding.

3. **Understandibility**

Understandibility on a system's design can prevent a programmer to make any mistake on the Implementation phase. Besides that, it also helps to make any reconstruction to the system and avoid any confusion inthe future.

4. **Adaptability**

Adaptability for a design is an estimation on how easy a changes can be made to that design. This is why it is very important to cohere the components in a source code so that the adapatability process can be done at the same time without involving all the units or the objects. Besides that, the design process must be parallel and consistent with the development implementation and the division between the components must be clear and understandable so that it is easier to revised.

5. **Graphic User Interface (GUI)**

The implementation of the graphic user interface for this system is designed uniqely and understandable to suite the user's need. It is very easy to use because it use the natural language which are in English and the instructions are cleared and understandable to any stages of users.

The interface of this system also helps to make the learning fun and enjoyable.

As for the system's coding, every components in the program consists of three main aspects. There are :

1. **Control Structure**

   Most of the control structure for the suggested component during the design phase will be intepreted in codes. The designs are not important but the program structure must be reflex with the design of the control structure. The best code is using the top to bottom method.

2. **Algorithm**

   The design program usually classified the algorithm in a code configuration. This will help to produce codes which can be implemented effectively and balanced with the design quality, standard and user's specification.

3. **Data Structure**

   During the programming design, every programmer should always update and save the datas so that the control and the manipulation of the data will be much easier.

6.3. Development Tools

The development tools for this system are as follows :

a. Software tool : Microsoft Visual Basic 6.0

b. Operation System : Windows XP

c. Processor : Pentium 4/ Pentium 3

d. Graphical User Interface : Microsoft Visual Basic 6.0

e. Sound and Image card

6.4 Documentation

The system documentation is a guidance to user who will use the system. It contains a detailed explanation of the system's development. A good documentation gives a clear picture of each phases in the development of the system.

6.5 Conclusion

This chapter describes about the changes of the phases in a system development. We can see that the design we made in System Design for example the algorithm and the module changed into codings.

7.0 : System Testing

7.1 Introduction

Testing is the crucial element in the control process and guarantees the software's quality or the developed system. This phase consists of the evaluation of the system's specification, design and coding throughout the system development. Furthermore, this phase also determined whether the developed system operates according to the specification.

Generally, the objectives of the testing phase are :

- Find and recognize errors and mistakes in the source code
- Determine whether the system's implementation functions well.
- Correct any errors and mistakes that occurred.

During the system development, a good testing process manages to identify errors which cannot be identified in Analysis and design phase or implementation.

Errors can be divided to three classes which are:

1. **Compile Error**

   This error usually happens because of errors in the source code and it can be identified during the compile process. The compiler will give a warning message.

2. **Run time Error**

This error usually happens during the implementation or the execution process. It happens when a control, object or a variable in the source code could not be implemented because of the programmer mistake or illogic process in the source code for example the infinity loop or the used of a variable without any instantiation.

3. **Logical Error**

This error happens when a program produce a mistake output. This situation can be identified easily when the produced output is different from the expected output. This error can be fixed by a programmer.

7.2 System Testing Strategy

A good strategy can assist in controlling a fully system testing process. Furthermore, it also helps to increase the effectiveness of the testing phase to the development system.

List the testing objective

Implement the testing process

Evaluate the testing result.

For this system, there ere three steps involved in the testing process:

1. **Unit Testing**

   In unit testing, the test is implemented to components which are inside the module. For example, in the On-going test module, the components inside this module are the Speech test, the Motion test and the Vision test.

2. **Module Testing**

   In Module testing, the test is implemented to each module in the system. For Adaptive Expert Knowledge system, there are two modules which are the On-going test module and the Expert Knowledge module. So, the test is implemented to each module separately so that it is easy to identified any error.

3. **System testing**

   In System testing, the test is implemented to a full system meaning that all the modules in the system are implemented together. In this stage, we will know whether the implemented result is exactly like the expected output.

7.3 Unit Testing

Adaptive Expert knowledge consists of two modules which are the On-going test module and the Expert knowledge module. There are three units consists in each modules. The units are the Speech, Motion and Vision.

In unit testing, we will find errors in each unit for every module. It is easier to find errors after the division, for example the syntax error.

We took the On-going test as an example. The units are the On-going test for Speech, the On-going test for Motion and Vision. So, we will test each On-going test differently. This is easier because we will notice if there is any logic and syntax error occurred because it is a calculated function process.

Same goes to the Expert Knowledge. We will run the unit testing process to each domain knowledge. From here, we will notice most probably the run time error since we use the loop to show the next form.

7.4 Module Testing

After the unit testing, we will proceed to the module testing. For the On-going test module, the most important is the display of the score for each domain knowledge or units. The most probably errors occurred in this test is the run time error since it is a calculated functions process.

As for the Expert Knowledge module, we will notice either the flow of the forms runs according to what had been planned or not.

7.5 System Testing

During this stage, we will run the system thoroughly and test it. Not like the other two tests where we only tests parts of the program.

When we run the system, the first flow it will check is the Expert Knowledge module, then the On-going test module.

In the Expert Knowledge module, the most important part is the flow between the forms. It must followed according to what had been planned before because not all the notes can be accessed, some must be hidden according to the user's level. In other words, the link flows is very important.

As for the On-going test module, the most important part is the calculation. We have to make sure that all the functions, variables and the procedures function well.

7.6 Conclusion

This chapter describes about the System Testing phase. This phase is one of the crucial phases during the development process. When we executes our system, we have to remember that there are three types of errors, and when we knew which type of error occurred, its easy to us to make a corrections.

8.0 : Discussion

8.1 Introduction

A system must be evaluated to recognize its ability. Before this system is fully applied, a developer has to make sure errors in the system are as minimum as it can. This assessment has to be made in a short period of time because there will be so many technical errors exist during this phase and need to be solved. All of these problems which occurred will be counted during the system's development phase and the solutions to these problems will be found through researches and findings. The 'try and error' method is used during the coding phase to solve the problems.

8.2 Problems faced and the solutions.

Followings are the problems occurred during the development of Adaptive Expert Knowledge and the solutions.

1. **Scope Definition**

   In this stage, I had a problem to determine the scope definition for this project. It happens because this system will be integrated with the Intelligent Assessment

System. So, I get confused with the definitions of this system and the most important is, the intelligence of this system.

Solutions :

My supervisor, Prof. Dr. Roziati Zainuddin gave a detail explanation to me, and it helps me a lot. She helps me to determine the scope definition for this system for example, she explains to me what is the knowledge base and how to implement the knowledge base for this system. Other than that, I also made some researches and if I have problems understanding it, I will refer to her and she will explain to me in details.

2. System Design

In this phase, the biggest problem is to determine the modules. At first, the Pretest is included as one of this system's module, but then, because of the integration with the Intelligent Assessment System, the Pretest module became the Intelligent Assessment System's module.

Another problem is to design an interface which is user friendly and interesting. The interface must be easy, the instruction is clear and should not make the user confused, so we have to assume that not all the user good at using computer for example the children. This system is suitable for all ages and minimum requirement for the user is they have basics on how to use the computer.

Solution :

After having some discussion with the supervisor, the problems which occurred in this phase solved. For the modules' problem, it is clear that the Pretest is not included as the module for the Adaptive Expert Knowledge module because this system is a knowledge based system.

As for the interface, my supervisor advised that the interface must be easy and interesting because it is important to make the user enjoy using this system.

3. **Lack of knowledge in using Visual Basic Programming**

   I never used nor implement a program using the Visual Basic Programming before so, it's quite a problem to me to build this system because I had to read and learn about this programming language first.

   I had to make sure that I had to learn it as fast as I could so that the flow of building this system is not disturbed..

   Solution :

   To face this problem, I bought a book for my reference. The title is Programming in Visual Basic 6.0.

   It is a very good book because it helps a lot especially for a beginner like me.

4. **Linkage between forms**

Because of the forms are quite a number so, it is really confusing to link all of them altogether. Most of the errors occurred here for example, the links which determined the level of students is not following the flow according to the level specification, so there are no difference between the Link A which is the low-level student with the high-level student which used the Link C

Solutions :

I spend quite a long time to figure out the coding to specified the student's level and link all the forms correctly. It gets confusing sometimes because sometimes the forms links like in a loop. So, after running through the coding, I figured out the mistakes and correct it.

5. Problem with the On-going test module.

In this module, the problem is the coding. The biggest problem is when the marks didn't appear on the Score form.

Other problem is error in calculation the marks for the test.

Solution :

After concentrating on the coding, I figured out the problems, sometime it was a typing error, syntax and logic problem.

8.3 System's Assessment by User

My friends who are not a Computer Science students are the user for this system. They will tell me the system's drawback especially the interface. From there, I will know how to create a user friendly system. It is easier for me to use a non-computer science students because I will get more information about their difficulties in using the system and capture their needs.

They also give advices about the expert knowledge module which is the notes. on how to make it readable, understandable and fun to read.

8.4 System's Advantages

Followings are the system's advantages.

1. **Links in Expert Knowledge Module**

   The links will adapt to the student's skill or knowledge about the domain knowledge which are the Speech, Motion and Vision.

   The links are according to the user's achievement during the Pretest question. If they get marks which are below 7 then the user is categorized in a Low-level student but if their marks are below than 14, they are Intermediate-level user whereas if their marks are more than 13, they are the High-level student.

Link A is enabled for users who are in the Low-level categories. The notes are more and details than the other links. It is because, they are lack of knowledge about the domain knowledge so, they have to learn extras than the other levels.

For the Intermediate-level students, Link A and Link B is enabled. They are free to choose which links they want to access. If they want to learn more, they can click on Link A and vice versa.

Link C is enabled for the High-level student. The knowledge are simpler, sometimes in a points format. This level have more knowledge about the domain so we didn't want them to waste time learning knowledge which they already knew.

2. The On-going test Module

This module is very important because it will test the student's memory. Through this module, it will triggered the student's memory about the notes which they have just read. They have to answer the question to proceed to the next form.

This module is inserted between the Expert Knowledge Module. We put it that way because of we are using the Question-driven Understanding method which stated that we learn more through questions and sometimes

when we read, there will be questions arise and need to be answered to understand the knowledge.

3. **User-friendly interface**

This system is very easy to use. It only uses conventional buttons such as next, to go to the next module, exit button to exit the system and so on. It is suitable for all ages who have at least have basics in using the computer.

Message box will be prompted to guide the user while using the system for a reminder and information.

4. **Security**

This system has its own security to prevent from hackers or irresponsible user (in the application builder tools : Visual Basic 6.0).

8.5 System's Limitation

1. **Not a Web-based system**

This system is not a Web-based system, so any new information about the domain knowledge cannot be retrieved. For example, this system is not

linked to the Robotics web-sites to read the journals and latest information about the Artificial Intelligent field.

The questions also not a dynamically questions so it may lead to boredom.

2. **The Domain Knowledge**

This system only covers necessary parts of topics because it's a final year project. The important thing is to reflect the features, not the quantity.

3. **Database**

This system do not have any database, so it is quite difficult to create a security of this system.

8.6 System's Improvement

Adaptive Expert Knowledge system must be improved from times to times because it is potential to use it as a helper or guide the students in learning the Robotic domain. The more sophisticated the system; more students will be interested in learning this domain.

1. **Web-based system**

   In the future, this system should be a web-based system so that it can access to the Artificial Intelligent web-sites especially the Robotic domain. User will have the latest information about the domain knowledge and it will increase the curiosity and enthusiasm about this knowledge.

   Other than that, it also helps the developer to make this system more interesting by uploading new notes and questions.

   It also can create a communication between the developer and the user. The developer will know what the user's needs and try to improve the systems according to the needs.

2. **Database**

   This system is more secured if it has a database. It will prevent the system from irresponsible users.

8.7 Experience

There are lots of experiences I get while building this system. The most important is while we dealing with the user. We have to build a system which

meets the user's specifications. This is important because we build this system to help them learn this knowledge in a fun and interactive way.

I also get the chance to implement some of the subjects we learn during this course such as System Analysis and Design, Cognitive Science and so on. Now, I had experienced on how to use all these knowledge and it is very important in the future.

I also learn how to use Visual Basic Programming Language and Macromedia Flash MX. This is good start for me to learn more about other program in order to be a good programmer and I hope that I have a chance to improve this system more.

8.8 System's Conclusion

This system is a good system to capture the student's weakness in learning. It also help the students to memorize using the Cognitive Science method where we use images as notes for example.

Besides that, it also helps the students understand what they don't about the knowledge. According to the Question-driven Understanding method, the main

point is to instigate the student's thinking skills that is driven by his questions and goals to acquire knowledge.

Unfortunately, this system has weaknesses but if this system is improved in the future, it will be a strong system which will helps many students and lectures to gain new knowledge in this field.

8.9 Conclusion

As a conclusion, this system needs to be improved in the future because the domain knowledge for this system evolves. There are so many interesting news and researches needs to be read and learn in order to master this knowledge.

APPENDIX A

THE CODING

The Coding

Coding inside the Form

1. The Expert Knowledge Module

```
Private Sub cmdBack26_Click()
' Go to previous page
   frmsp2a25.Show
End Sub
```

- This is a command function for a Back button.
- If the user click the button, this command will be executed.

```
Private Sub cmdExit26_Click()
' Exit the system
   MsgBox "Do you wish to perform this action?", vbYesNo, "Exit"
   If vbYes Then
      frmSpeech2a.Show
   Else
      frmsp2a26.Show
   End If
End Sub
```

- This is the command function for Exit button
- If the user click this button, this command will be executed and return to the Main page.

```
Private Sub cmdHome26_Click()
' back to Main page
  frmSpeech2a.Show
End Sub
```

- This is the command function for Home button
- If the user click this button, this command will be executed and return to the Main page.

```
Private Sub cmdNext26_Click()
' go to previous page according to the links
  If TotalSpeech <= 6 Then
    frmsp2a27.Show
  Else
    MsgBox "Do you wish to have further notes?", vbYesNo, "Further Notes"
    If vbYes Then
      frmsp2a27.Show
    Else
      frmsp2a28.Show
    End If
```

End If

End Sub

- This is the command function for Home button
- If the user click this button, this command will be executed and return to the Main page.

2. The On-going Test Module

1. This is the coding for the Fill in the blanks question.

```
Private Sub CmdAnswer_Click()
Dim strFirst As String
Dim strSecond As String
Dim strThird As String

strFirst = txt1a.Text
strSecond = txt1b.Text
strThird = txt1c.Text

If strFirst = "acquisition" Then
   Call CountVIS
   Call CountTotalVIS
   img1a.Visible = True

Else
   Call CountTotalVIS
   MsgBox " Your answer is wrong." & vbNewLine & _
   "Please refer to notes.", vbExclamation, "Wrong"
End If
```

```
If strSecond = "normalisation" Then
   Call CountVIS
   Call CountTotalVIS
   img1b.Visible = True
Else
   Call CountTotalVIS
   MsgBox " Your answer is wrong." & vbNewLine & _
   "Please refer to notes.", vbExclamation, "Wrong"
End If

If strThird = "recognition" Then
   Call CountVIS
   Call CountTotalVIS
   img1c.Visible = True
Else
   Call CountTotalVIS
   MsgBox " Your answer is wrong." & vbNewLine & _
   "Please refer to notes.", vbExclamation, "Wrong"
End If
   cmdAnswer.Enabled = False
   cmdNotes.Enabled = False
   cmdClose.Enabled = True
End Sub
```

```
Private Sub cmdClose_Click()
   txt1a.Text = ""
   txt1b.Text = ""
   txt1c.Text = ""
   img1a.Visible = False
   img1b.Visible = False
   img1c.Visible = False
   cmdAnswer.Enabled = False

   frmvisb6.Show
End Sub

Private Sub cmdNotes_Click()
   frmNQ1.Show
End Sub

Private Sub txt1c_Change()
   cmdAnswer.Enabled = True
End Sub
```

2. This is the coding for the Objective question.

```
Private Sub CmdAnswer_Click()
If opt3b.Value = True Then
   Call CountVIS
   Call CountTotalVIS
   img2b.Visible = True
Else
  Call CountTotalVIS
   MsgBox " Your answer is wrong." & vbNewLine & _
   "Please refer to notes.", vbExclamation, "Wrong"
End If
   cmdAnswer.Enabled = False
   cmdClose.Enabled = True
   cmdClue.Enabled = False

End Sub


Private Sub cmdClose_Click()
   opt3a.Value = 0
   opt3b.Value = 0
   opt3c.Value = 0
```

```
    opt3d.Value = 0
    img2b.Visible = False
    cmdAnswer.Enabled = False

    frmvisb7.Show
End Sub

Private Sub cmdClue_Click()
    frmNQ3.Show
End Sub

Private Sub opt3a_Click()
    If opt3a.Value = True Then
        Call CountTotalVIS
        cmdAnswer.Enabled = True
    End If
        opt3b.Value = 0
        opt3c.Value = 0
        opt3d.Value = 0

End Sub
```

```
Private Sub opt3b_Click()
    If opt3b.Value = True Then
      Call CountTotalVIS
      cmdAnswer.Enabled = True
      opt3a.Value = 0
      opt3c.Value = 0
      opt3d.Value = 0
    End If
End Sub

Private Sub opt3c_Click()
    If opt3c.Value = True Then
      Call CountTotalVIS
      cmdAnswer.Enabled = True
    End If
      opt3b.Value = 0
      opt3a.Value = 0
      opt3d.Value = 0
End Sub

Private Sub opt3d_Click()
    If opt3d.Value = True Then
```

```
    Call CountTotalVIS
    cmdAnswer.Enabled = True
  End If
    opt3b.Value = 0
    opt3c.Value = 0
    opt3a.Value = 0
End Sub
```

Coding inside the Module

1. This is the coding for the On-going Test Module

```
Public SP As Integer

Public VIS As Integer

Public MOT As Integer


Public TotalSP As Integer

Public TotalVIS As Integer

Public TotalMOT As Integer


Public SSP As Integer

Public SMOT As Integer

Public SVIS As Integer


Public TSP As Integer

Public TVIS As Integer

Public TMOT As Integer


Public CGradeSP As Integer

Public CGradeVIS As Integer
```

Public CGradeMOT As Integer

Public Static Function CountSP()

SP = SP + 1

Call TTSP

End Function

Public Static Function CountVIS()

VIS = VIS + 1

Call TTVIS

End Function

Public Static Function CountMOT()

MOT = MOT + 1

Call TTMOT

End Function

Public Function CountGradeSP()

CGradeSP = (TSP / SSP) * 100

End Function

Public Static Function CountTotalSP()

TotalSP = TotalSP + 1

```
Call SumSP

End Function

Public Static Function CountTotalVIS()

TotalVIS = TotalVIS + 1

Call SumVIS

End Function

Public Static Function CountTotalMOT()

TotalMOT = TotalMOT + 1

Call SumMOT

End Function


Public Function CountGradeVIS()

CGradeVIS = (TVIS / SVIS) * 100

End Function


Public Function CountGradeMOT()

CGradeMOT = (TMOT / SMOT) * 100

End Function


Public Function SumSP()

SSP = TotalSP

End Function
```

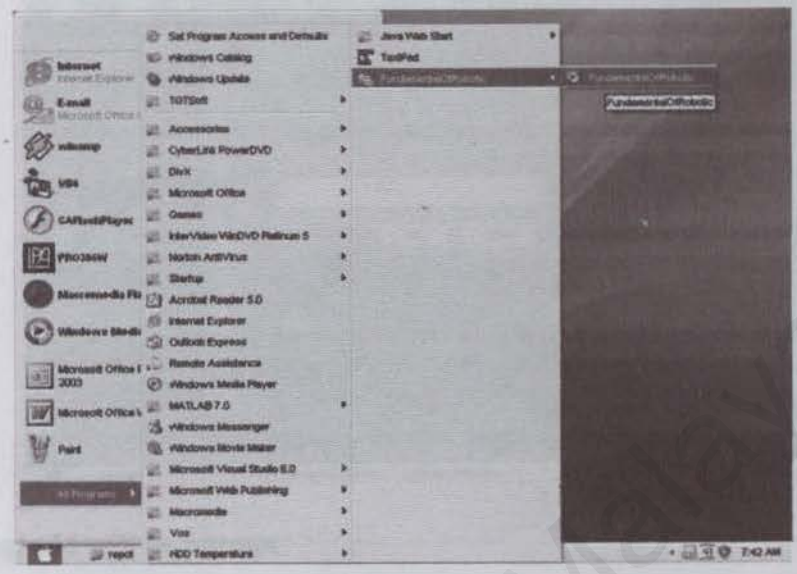
```
Public Function SumVIS()
SVIS = TotalVIS
End Function

Public Function SumMOT()
SMOT = TotalMOT
End Function
Public Function TTSP()
TSP = SP
End Function

Public Function TTVIS()
TVIS = VIS
End Function

Public Function TTMOT()
TMOT = MOT
End Function
```

APPENDIX B

THE CODING

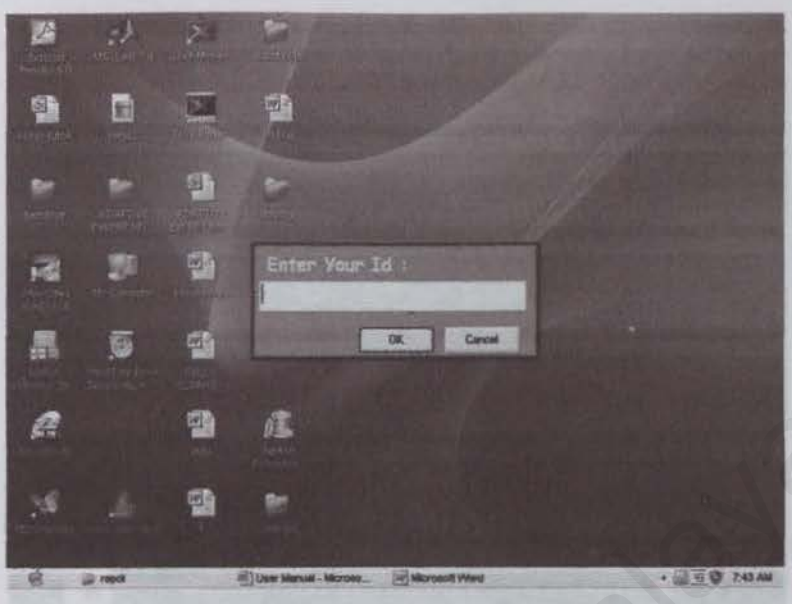
User Manual

Step 1



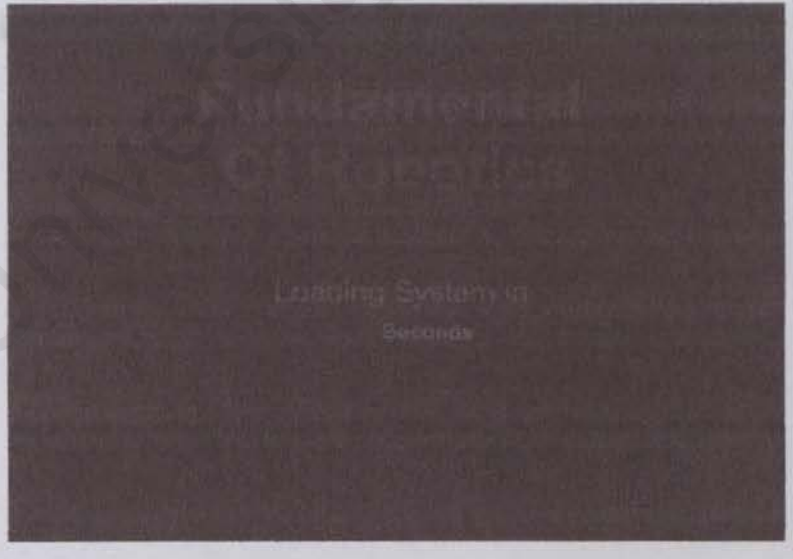
- Point the cursor to Start button
- Point to All Programs
- Find the Fundamental Of Robotic and then click it

Step 2



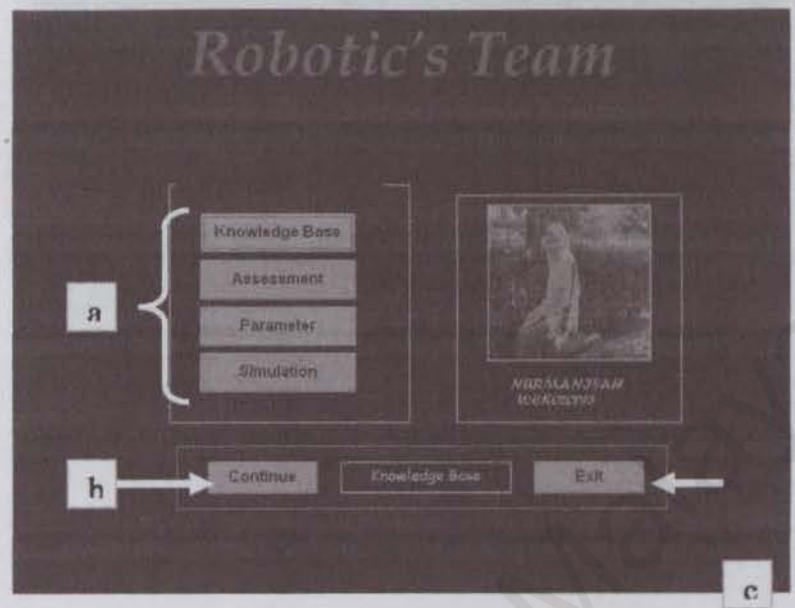
- A Login Id will be prompt
- Enter the Login Id

Step 3



- Automatically, this form will be display
- Just wait

Step 4

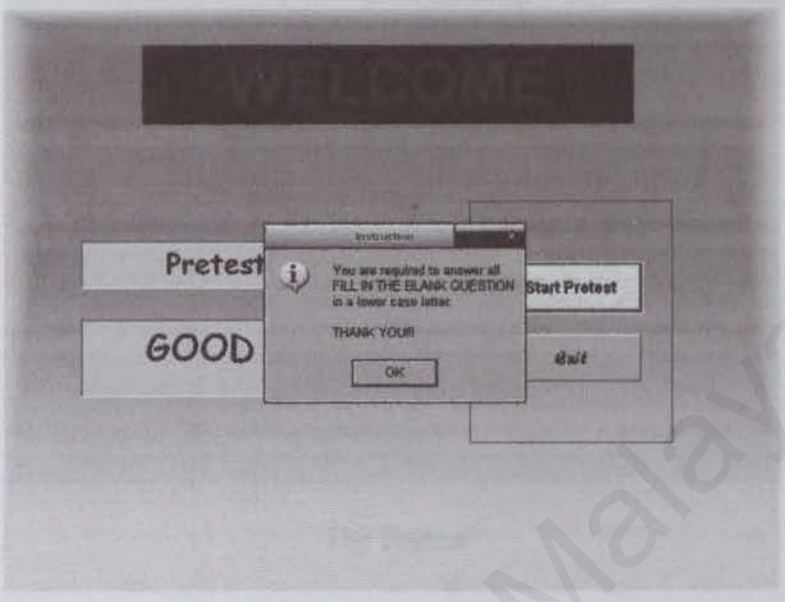


a. Click here to know the developer of this system

b. Click Continue to proceed to the next stage

c. Click Exit to exit the system

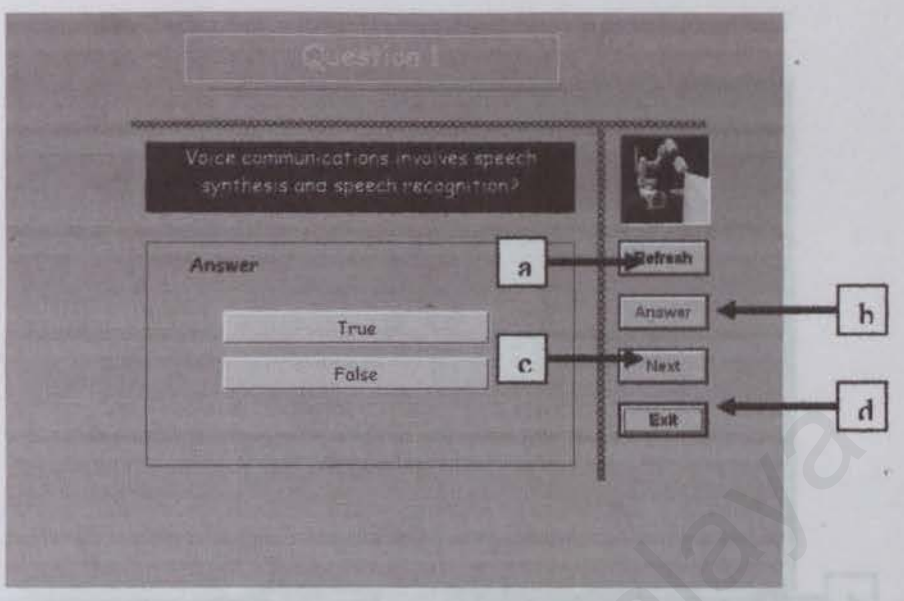
Step 6



The Pretest's Main page

- A message box will be prompted
- It tells the user to use the small letter case to answer the fill in the blanks questions

Step 7



The Pretest

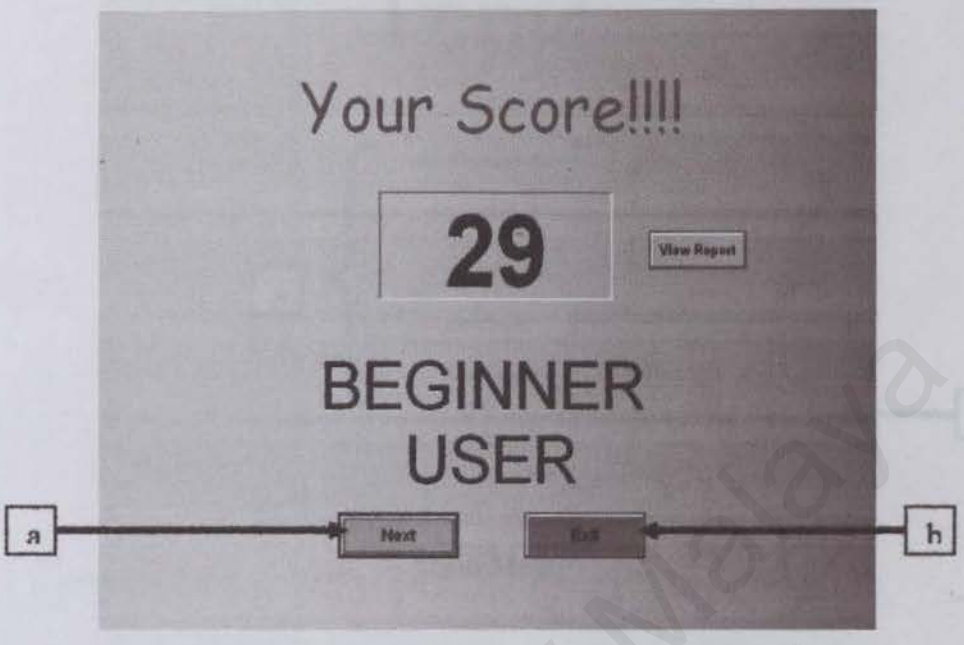
a. Click Refresh to erase all answers

b. Click Answer to check your answers

c. Click Next to turn to next page

d. Click Exit to exit the system

Step 8

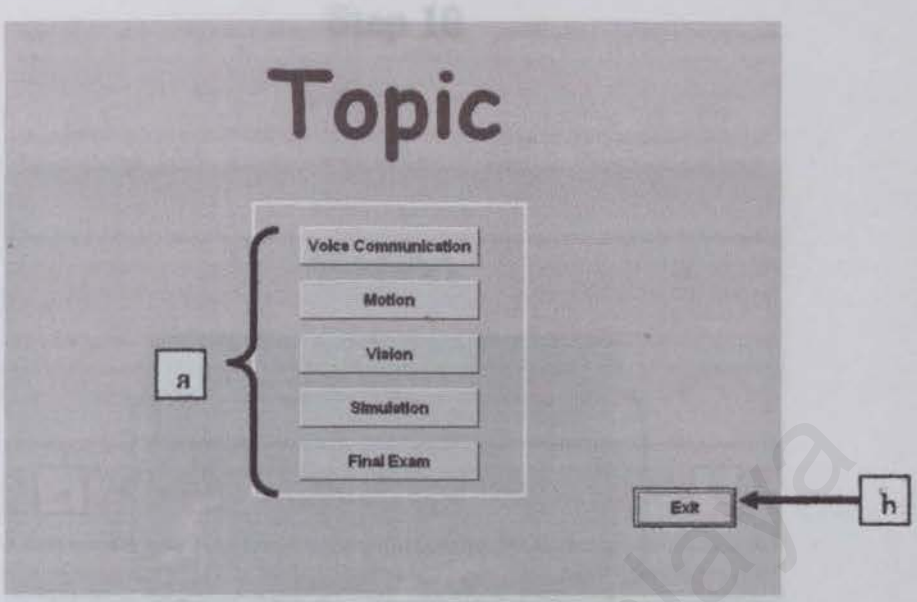


Score

a. Click Next to proceed to the next stage

b. Click Exit to exit the system

Step 9

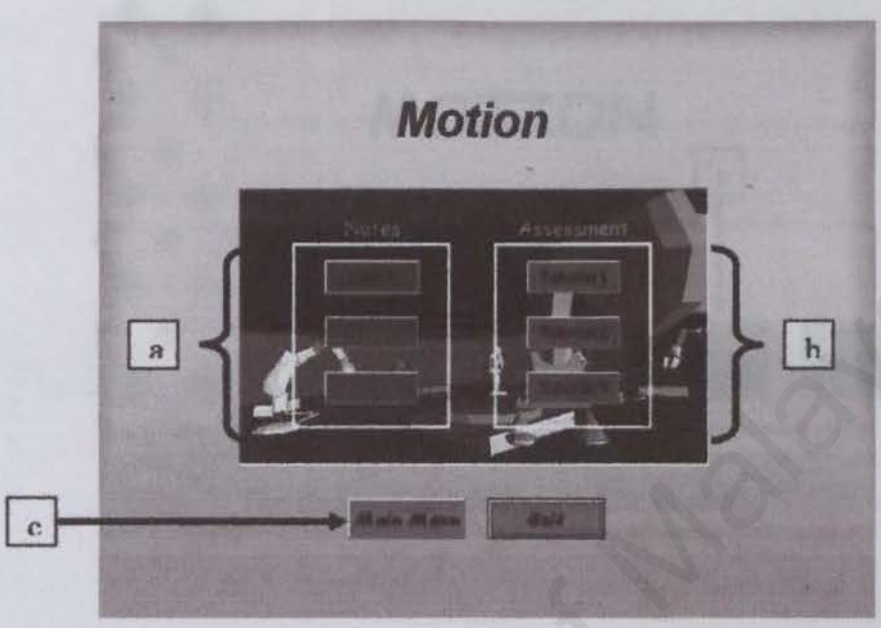


Main Menu

a. The List of topics in Fundamental of Robotic. Choose one and click it.

b. Click Exit to exit the system

Step 10



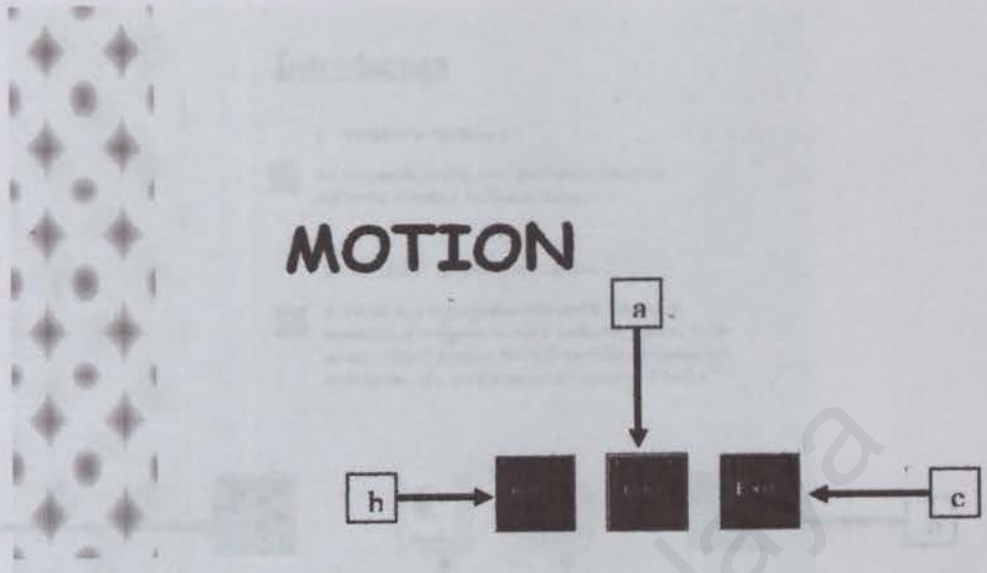
The Topic's Main page

a. Links to Expert Knowledge or notes according to topics you have chosen (This links is according to your level. Click on the enabled links)

b. If you want to answer the Tutorial, click here.

c. Click Main Menu to go back to the Main Menu page.

Step 11



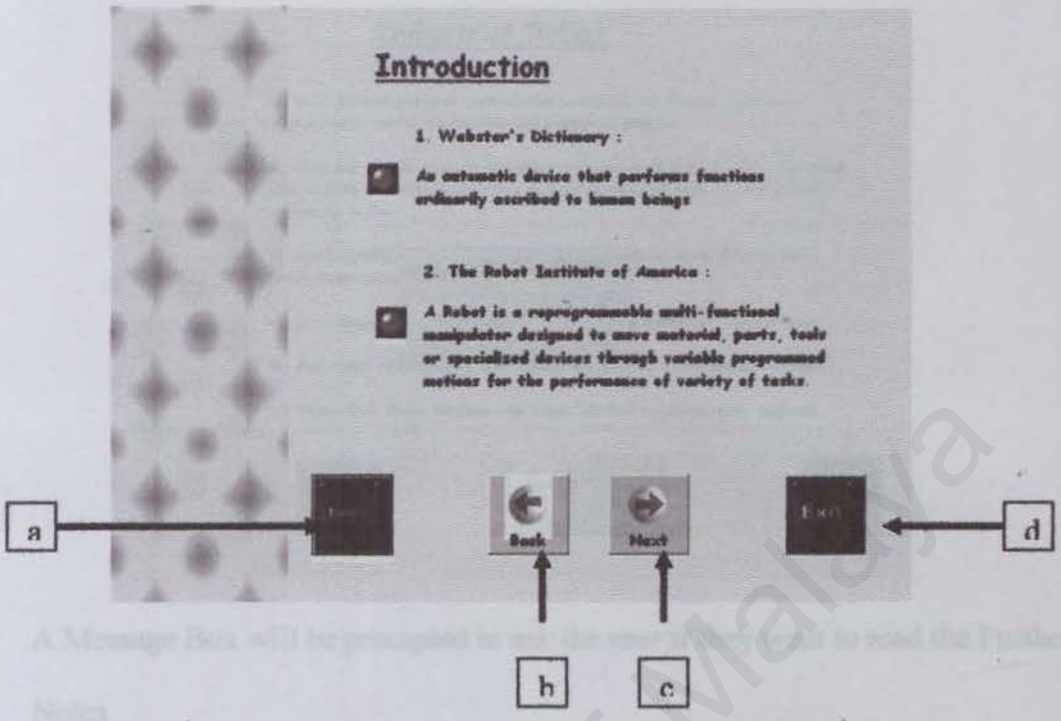
The Expert Knowledge module or notes

a. Click Enter to go to the next page

b. Click Home to go back to the Topic's Main page

c. Click Exit to exit the system

Step 12



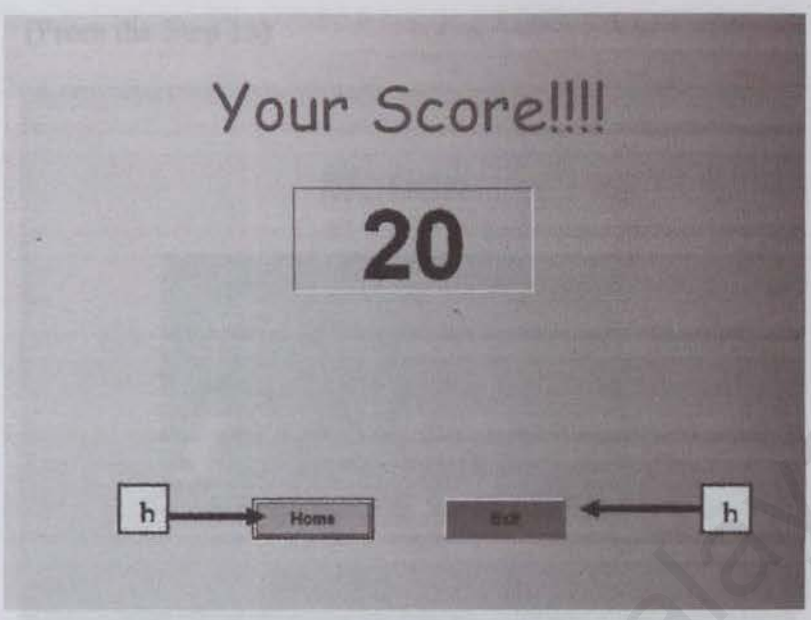
a. Click Home to go back to the Topic's Main page

b. Click Back to go to previous page

c. Click Next to go to the next page

d. Click Exit to exit the system

Step16



The Score page

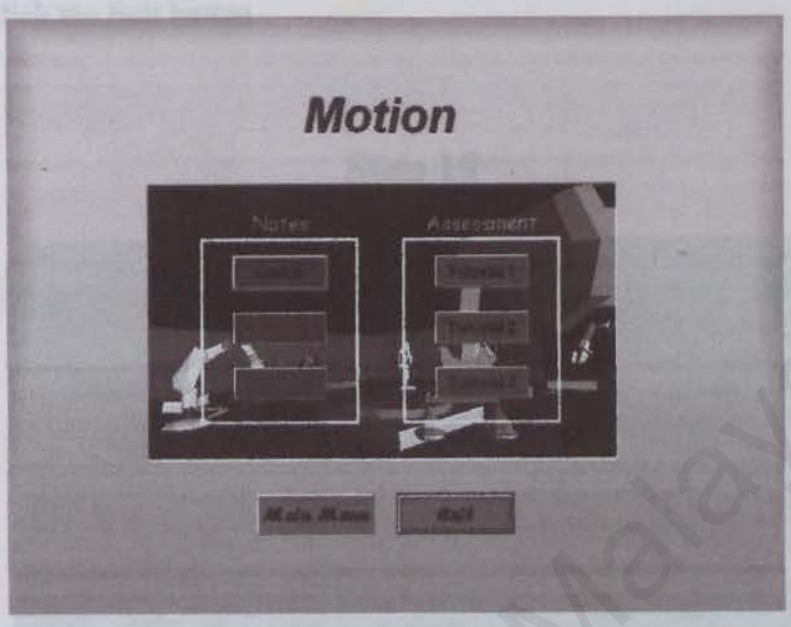
a. Click Home to go back to the Topic's Main page

(To read the notes but take the other link, you can click the Home button)

b. Click Exit to exit the system

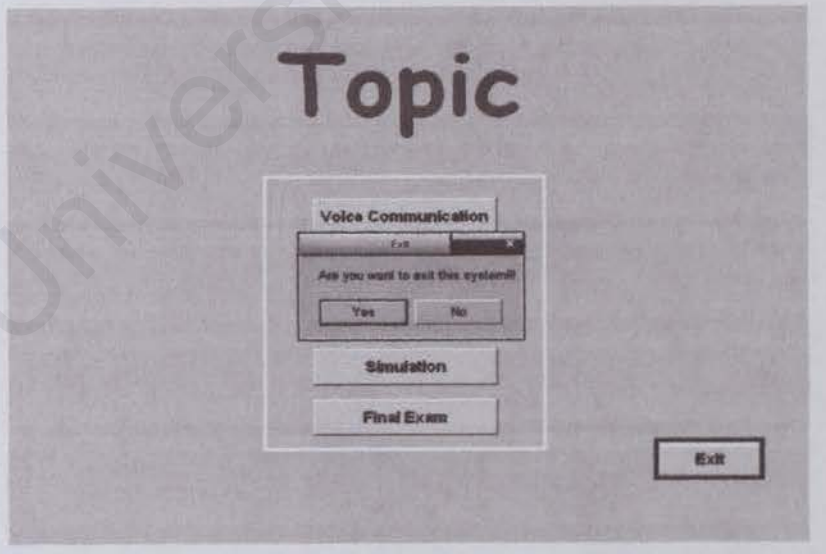
Step 17: You can read the notes from another links.

(From the Step 16)



The Topic's Main page

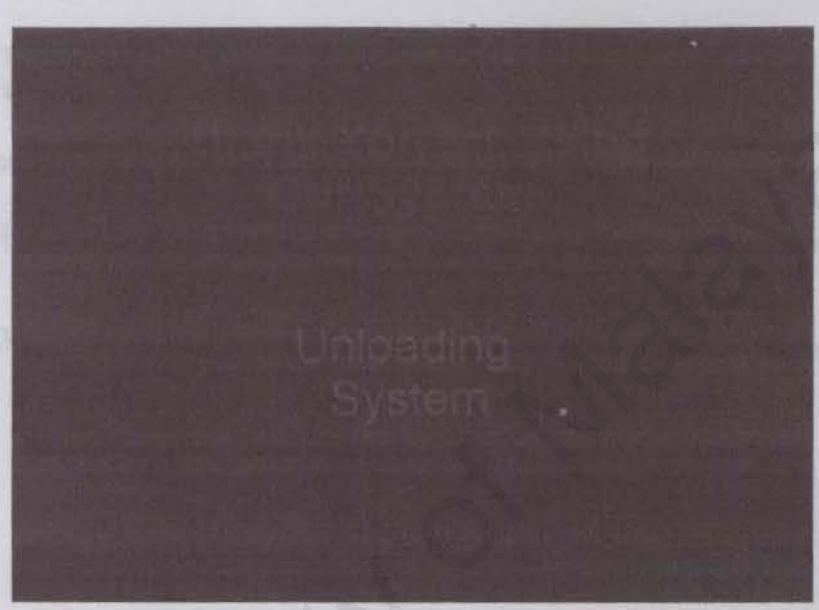
Step 18



Main Menu

- A Message Box will be prompted asking whether you want to exit the system, if you click the Exit button

Step 19



The Unloading page

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Bradley.J.C (2002). Programming in Visual Basic. 6th ed. McGraw-Hill Irwin